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Physical Therapy Management of a Non-Ambulatory Individual After Diagnosis of Postinfectious Longitudinally Extensive Transverse Myelitis: A Case Report

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Abstract

Background: Transverse myelitis (TM) is a rare inflammatory condition that disrupts spinal cord function and leads to sensory, motor and autonomic dysfunction below the neurological level. While medical management and patient outcomes rely heavily on diagnostic timing and accuracy, multidisciplinary care including acute physical rehabilitation is recommended to maximize functional independence and quality of life of affected individuals. **Purpose:** This report discusses the rehabilitation course of an individual with a severe case of TM following varicella zoster, West Nile and mycoplasma infections. Medical details are also shared to illustrate the rare nature of this case. **Case Description:** A 58-year-old Caucasian male (Client A) without remarkable medical history presented with a slow onset of neurological symptoms leading to paralysis four weeks after an episode of shingles. A late diagnosis of longitudinally extensive transverse myelitis was confirmed yet no single infectious agent was identified as the cause. Through rehabilitation, he learned functional mobility skills but experienced minimal neurological recovery and remained non-ambulatory at discharge. **Interventions:** Medical treatments used to target neurological recovery included acyclovir, doxycycline, corticosteroids, plasmapheresis and intravenous immunoglobulin. Client A also participated in inpatient rehabilitation dosed at three hours per day, five to six days per week, for nine weeks. Interventions included task-specific training, seated balance training, functional electrical stimulation and weight-bearing exercises. **Outcome Measures:** ASIA Impairment Scale, Functional Independence Measure, Modified Ashworth Scale, Range of Motion, and Manual Muscle Testing measures. **Discussion**: The increased time required to diagnose Client A, along with his adverse reactions to standard medical treatments, may have negatively impacted his prognosis. Despite this, he improved in all outcome measures with inpatient rehabilitation and was discharged to his home.

Key Words: Transverse myelitis; postinfectious; physical therapy; rehabilitation; non-ambulatory

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Background

Transverse myelitis (TM) is a term for a group of rare inflammatory disorders that disrupt the spinal cord, leading to sensory, motor and autonomic impairment below the affected level. While only 1,400 cases are diagnosed in the United States annually, the presentation and prognosis of each case is unique and often relates to the specific etiology.[1-3] The differential diagnosis list for TM is long, however, and tends to result in diagnostic confusion. Infectious myelitis, autoimmune conditions and demyelinating diseases such as neuromyelitis optica and multiple sclerosis are the most prevalent items on this list.[2,3] Determining the correct etiology is critical to guide medical decisions and optimize patient outcomes.[4] One-third of diagnosed individuals experience poor neurological recovery, defined as the inability to ambulate. The remaining two-thirds will experience full or moderate recovery.[4-6] Very few prognostic factors have been identified in the literature. A multidisciplinary approach including effective medical treatment and physical rehabilitation is supported to improve longevity, functional independence and quality of life in individuals with transverse myelitis.[7]

The most common presentation of TM is a rapid onset of sensory and motor loss in the trunk and lower extremities resulting in impaired ambulation and even paralysis of the lower extremities.[4] Severe back pain and sensations of a constricting band at the sensory level are often reported.[2] Urinary retention and incontinence are some of the first symptoms observed. Men and women of all races are affected equally, with the greatest incidence occurring in the second and fourth decades of life.[1,4] TM in children is less common and often infectious in nature.[2] For most individuals, symptoms reach peak intensity within two weeks of the disease course and improve with medical care. [2,3,5]

Fifty percent of cases present following an infection, usually in immunocompromised individuals.[4] Enterovirus, cytomegalovirus, varicella zoster, Epstein Barr virus, human immunodeficiency virus, West Nile virus and mycoplasma are among the dozens of agents that can incur TM.[2,3,8] In most cases, it is unclear if the foreign organism directly insults the cord or triggers an adverse autoimmune reaction against the nervous system.[2,8] Several autoimmune disorders have also been cited as causes of TM, with the most common being systemic lupus erythematosus, Sjogren's Syndrome, antiphospholipid syndrome and neurosarcoidosis.[2-4] TM may also present as the first sign of a demyelinating disease, such as multiple sclerosis (MS) and Neuromyelitis Optica (NMO).[2,3,9] Research has shown that individuals with concurrent NMO tend to have poorer prognoses and higher incidences of relapse. Thus it is strongly advised that the medical team looks for NMO- specific markers in cases with suspected TM to guide treatment decisions.[10,11] Spinal cord infarction, compressive neoplasms and toxin-exposure have also been observed to lead to TM. Fifteen to 30% of all TM cases are labeled idiopathic. This term, however, is selective. Evidence of all other etiologies must be excluded to be defined as idiopathic according to the Transverse Consortium Working Group criteria.[2,4]

Diagnosis of TM is dependent on patient presentation, medical history and results of several diagnostic studies including magnetic resonance imaging (MRI), lumbar puncture and serum pathology. MRI of the brain, brainstem and spinal cord is used to exclude evidence of compressive etiologies and explore signs of spinal cord inflammation and edema, as identified by a T2-hyperintense signal with gadolinium enhancement.[12] This signal is the classic diagnostic feature of TM and is most often observed in the cervical and upper thoracic spinal segments.[13] Furthermore, the number of spinal cord segments affected will classify TM into *acute transverse myelitis (ATM)* or *longitudinally extensive transverse myelitis* (LETM).[2,12] ATM is defined by swelling spanning one or two spinal segments.[2] LETM describes edema that surrounds three or more levels of the cord.[2] These separate classifications are highly correlated with specific causes of TM, as well as with patient prognosis. For example, LETM is highly associated with NMO and increased probability of relapse.[11,12] Cerebrospinal fluid analysis and serum studies are indicated to explore other markers of inflammation, infection or underlying

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disorders. Computed tomography may also be used to investigate mass lesions compromising the nervous system, especially when MRI is not immediately available.

Medical treatment decisions rely heavily on the nature of the transverse myelitis. High dose intravenous (IV) and oral steroids are administered in most cases to reduce inflammation and edema. Plasmapheresis may be used to filter out harmful antibodies if autoimmune or infectious etiologies are suspected.[14] Intravenous immunoglobulin (IVIg) is an alternative for plasmapheresis and has been indicated in other autoimmune neurological diseases, such as Guillain Barré Syndrome.[15] The mechanism of this intervention in this population is unclear yet hypothesized to reduce harmful antibody activity by administering new antibodies intravenously. More recently, IV cyclophosphamide in combination with plasmapheresis has shown to be beneficial in severe cases of TM.[14]

The greatest complication of transverse myelitis is impaired mobility. The sequelae of immobility can lead to serious secondary health conditions and premature mortality. Thus, as in all cases of spinal cord injury, action must be taken to preserve as much movement as possible and promote individually adapted physical activity regimes. The role of acute physical rehabilitation in cases of transverse myelitis is to teach individuals strategies to preserve functional movements, increase independence and participation, and maintain cardiovascular and musculoskeletal health. The purpose of this case report is to discuss the rehabilitation process for a non-ambulatory individual with a severe case of postinfectious transverse myelitis following varicella zoster, West Nile and Mycoplasma infections. While this study focuses on rehabilitation process and outcomes, additional diagnostic information is included to illustrate the rare nature of this particular case.

Case Description

This case presents Client A, an active 58-year-old Caucasian male who presented to an inpatient rehabilitation center after diagnoses of LETM of suspected postinfectious etiology. Client A was otherwise healthy with no remarkable past medical history. He resided in a rural area, was employed in a labor-intensive job and was independent with all activities prior to hospitalization.

Symptom Progression

For clarity, the timeline of Client A's disease progression will be in reference to his symptom onset. Client A's first remarkable event was an episode of shingles with a rash on his right lateral thoracic region just inferior to the axilla. He was prescribed a one-week dose of acyclovir, and his rash cleared shortly afterwards. On Week 4, he reported to his local emergency department with numbness that had spread from his right lateral chest wall distal to his right foot and left toes and was sent home with acyclovir to treat post-herpetic neuralgia. On the fifth week, Client A developed lower extremity weakness including a right foot drag and returned to the clinic for evaluation. Two live ticks were observed on the client. MRI of the brain, brainstem, and spinal cord were negative. He was provided a week's supply of doxycycline to treat a potential tick-borne infection and was sent home.

Table 1: Disease Progression Timeline

Week 1	Shingles rash developed. Prescribed Acyclovir.
Week 2	No reported changes.
Week 3	No reported changes.
Week 4	Rash had cleared. Numbness from axilla to right leg and foot. Treated for post-herpetic neuralgia.
Week 5	Right foot drop developed. Treated for tick-borne illness with doxycycline.
Week 6	Lower extremity weakness and numbness progressed. Treated with acyclovir for suspected VZV myelitis.
Week 7	Near complete bilateral LE paralysis. Acyclovir stopped due to acute kidney injury. Diagnosed with LETM per MRI. IV prednisolone and plasmapheresis started. Adverse reaction to plasmapheresis.
Week 8	Continued IV prednisolone. Started IVIg.
Week 9	Continued medical treatment in intensive care.
Week 10	Second round of IV prednisolone. Transfer to inpatient rehabilitation facility.

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Approximately 24 hours later, Client A returned to the hospital with progressive weakness, leaving him unable to ambulate. He was admitted to intensive care. Lumbar puncture revealed an elevated white blood cell count and 95% lymphocytes in the cerebral spinal fluid. All other cerebrospinal fluid (CSF) results and repeat MRI with and without gadolinium were unremarkable. Client A was treated with intravenous acyclovir dosed at 15 milligrams per kilogram for presumed varicella zoster virus (VZV)-induced myelitis. This treatment was stopped after 12 days due to evidence of an acute kidney injury and lack of neurological improvement.

On Weeks 6 and 7, Client A's symptoms progressed towards complete paraplegia. Repeat lumbar puncture was positive for IgG but not for IgM antibodies for VZV, West Nile, and mycoplasma. A third MRI series on Week 7 revealed spinal cord involvement, with a T-2 hyperintense signal spanning the C7-T6 spinal cord sections. Electromyography results for the lower extremities were normal, indicating intact peripheral nerves. Additional lab results are provided in **Table 2**. At this time, Client A was diagnosed with longitudinally extensive transverse myelitis and began treatment with intravenous (IV) methylprednisolone. Five doses were administered over five days, and then sliding scale insulin was administered as a result of prednisone-induced hyperglycemia. Plasmapheresis was also trialed during corticosteroid treatment but switched to intravenous Ig (IVIg) due to urticaria (See *Adverse Reactions*). A second round of five doses of IV methylprednisolone was started on Week 10 after conclusion of IVIg. Client A had another allergic reaction of unknown cause during the third dose, which delayed his discharge to his inpatient rehabilitation facility. One day later, after almost 10 weeks of symptom development, Client A arrived at a new facility for intensive acute inpatient rehabilitation and continued medical intervention.

Table 2: Lab Results Collected between Weeks 6 and 7

	Positive	**Negative**
Serum Work-up	vitamin B6 (+)	ACE, ANA screen, copper, CRP, ESR, folate, fT4, hepatitis panel, HIV panel, Lyme antibodies, NMO antibodies, RF, total protein, TSH, vitamin B1, vitamin B12, West Nile PCR
CSF Work-up	95% Lymphocytes, mycoplasma antibodies (+), VZV antibodies (+), WBC (102, +), West Nile IgG (+)	glucose, gram stain, Epstein Barr DNA, intracellular bacteria, Lyme PCR, malignant cells, meningitis panel, protein, VZV IgM, West Nile IgM
MS panel	myelin basic protein (+), oligoclonal bands (+)	albumin index
Cervical CT (A/P)		no masses detected
MRI (with and without gadolinium)	T2 hyperintense signal from C7-T6 spinal cord levels (3rd Series)	1st and 2nd MRI series negative

Abbreviations: (+) elevated; ACE angiotensin-converting enzyme; ANA antinuclear antibody; A/P anteroposterior view; CRP C-reactive protein; CSF cerebrospinal fluid; CT computed tomography; ESR erythrocyte sedimentation rate; fT4 free thyroxine; HIV human immunodeficiency virus; Ig immunoglobulin; MRI magnetic resonance imaging; MS multiple sclerosis; NMO neuromyelitis optica; PCR polymerase chain reaction; RF rheumatoid factor; TSH thyroid stimulating hormone; VZV varicella zoster; WBC white blood cell

Adverse Reactions

Client A trialed two doses of plasmapheresis that led to anaphylactic reactions, the latter being severe resulting in a rapid response during administration. The first dose contained 5% albumin in four liters of saline and led to pruritic reactions in both upper extremities that resolved quickly with oral diphenhydramine. Due to the potential benefits of this treatment, a second dose was trialed with reduced total albumin (5% albumin in three liters). The client was also pretreated with 50 milligrams of oral diphenhydramine. Approximately 45 minutes into the procedure, however, Client A developed

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hives, wheals, tachypnea, diaphoresis and a systolic blood pressure of 220 millimeters of mercury leading to a rapid response. Client A improved quickly with medical assistance. Immunology was consulted and discovered that Client A was allergic to human albumin. Plasmapheresis was discontinued and switched to intravenous Ig without adverse responses.

Just prior to discharge from intensive care, Client A had another allergic response during his fourth dose of his second round of intravenous methylprednisolone. No identifiable cause of this reaction was confirmed, and treatment was continued without issues at the next site.

Acute Rehabilitation Assessment

Upon admission to the acute inpatient rehabilitation center 10 weeks following his initial symptom onset, Client A presented without lower extremity motor function and varied sensory distribution. He reported having a "tight band" around his chest that made breathing difficult. Spasticity was also a primary complaint, as he noted having an average of 7/10 pain with spasms. Client A had been trialing intermittent catheterization but was switched back to a Foley catheter upon admission due to urinary retention and incontinence. An effective bowel program was not yet established. He had been using a manual wheelchair for mobility and a transfer board for transfers but still required moderate assistance for safety.

The following outcome assessments were administered by his multidisciplinary team upon admission: the American Spinal Cord Injury Association (ASIA) exam, the Functional Independence Measure (FIM), the Modified Ashworth Scale (MAS), strength testing in standard manual muscle testing (MMT) positions and range of motion measurements using goniometry. A physiatrist completed the entire ASIA exam. The team physical and occupational therapists also repeated the ASIA motor sections for the lower and upper extremities, respectively, to gather baseline scores and monitor changes throughout therapy sessions. The FIM was scored by various members of the team, including the nursing staff and neuropsychologist. The MAS, manual muscle testing and range of motion measurements were performed by the physiatrist and therapy teams. Scores for all assessments are found in **Table 3** on Page 8.

With ASIA testing, Client A presented with T4 ASIA B paraplegia. He had 0/5 strength per MMT in all bilateral lower extremity muscles but did have anal sensation. Increased tone per the MAS was observed throughout the lower extremities, yet accurate and reliable measurements were difficult to obtain due to Client A's severe pain responses during the exam. His range of motion in all joints was within functional limits, and he had 5/5 bilateral upper extremity strength. At the time of admission, he had absent reflexes in bilateral lower extremities. He did have intact proprioception in his first and second toes on his left foot and third and fourth toes on his right foot but had impaired proprioception at bilateral ankles and knees. All cranial nerves were intact, and vitals were normal.

Functionally, Client A required the most assistance with bathing, upper and lower body dressing, toileting, bowel and bladder management, and all transfers. He was able to manage his own trunk but required assistance with his legs during bed mobility. To hasten progress with mobility, a custom ultra lightweight manual wheelchair was ordered within the first several days of admission.

Physical Therapy Intervention

Client A participated in physical therapy for 90 minutes per day, five days per week, for seven and a half weeks and an additional 30-minute physical therapy session on one weekend day. Occupational therapy was dosed at the same frequency. Due to reduced therapy needs, Client A was downgraded to subacute rehabilitation status on the start of the eighth week of inpatient rehabilitation and then was discharged to his home after nine weeks of therapy.

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More than half of Client A's rehabilitation minutes were dedicated towards task-specific training. These included practicing transfers, bed mobility and wheelchair skills. Additionally, Client A practiced skills that mimicked work tasks during seated balance training. Several other balance exercises, including perturbation-based training, were practiced regularly. Aside from these interventions, Client A worked on improving tolerance to upright positions and weight-bearing in the standing frame. Additional therapy treatments included functional electrical stimulation training on an RT300 bike and biking on the Nu-Step. Lower extremity stretching and range of motion exercises were also incorporated into most sessions to reduce spasticity and prevent joint contractures.

Bed Mobility and Transfer Training

Upon admission, Client A required up to moderate assistance for bed mobility, especially for lower extremity management. He was unable to roll without assistance when no bed railing was provided. He had poor sitting balance and required use of upper extremities to hold himself in an upright position. He had performed transfers with a transfer board at his previous facility but had not been instructed on proper sequencing and required moderate assistance due to poor trunk control.

To progress his mobility, Client A was instructed to perform the above tasks in a procedural and repetitive manner. Factors that inhibited his learning were spasticity and fear avoidance behaviors. Client A developed aggressive and painful extensor spasticity in bilateral lower extremities after several weeks of rehabilitation that was often triggered with bed mobility and transfer tasks. During these episodes, Client A would tense up and hold his breath. To promote relaxation and reduce spasticity, Client A was instructed on deep breathing techniques and participated in sensory calming sessions provided by another staff occupational therapist. Client A was also advised to perform mobility tasks in a controlled and calm manner.

Over the course of the first two weeks, Client A progressed from requiring moderate assistance with bed and mat mobility to being independent with these tasks. Specifically, he was able to independently transition between short-sitting, long-sitting, side-lying on both sides, supine and prone positions while managing his own catheter tubing. Client A was able to progress to standby assistance with transfers with a transfer board by Week 3 and then was independent with the task by Week 6. During his last several weeks of rehabilitation, he was able to perform direct lateral transfers without a transfer board independently and safely. Though practiced over multiple sessions in his final weeks of therapy, Client A was only able to achieve floor transfers with maximum assistance.

Wheelchair Mobility Training

Client A was provided a loaner manual wheelchair with a rigid contour back and an air cushion upon admission. A custom ultra lightweight manual wheelchair was ordered within the first several days to hasten his progression with wheelchair skills. Within the first week, Client A practiced indoor and outdoor mobility over several surfaces, including smooth flooring, carpet, and uneven terrains. Client A also practiced ascending and descending a curb cut-out and a traditional grade ramp with hands-on assistance. By the second week, he earned independent mobility rights around the hospital campus and courtyards. Over the course of therapy, he performed the same wheelchair mobility skills over more difficult terrains, including small and large gravel, grass and dirt. Car transfers were practiced with his spouse's vehicle on the fourth week, after which Client A achieved independence with the task with assistance of his spouse and permission to go out into the community with her on the weekends. Client A's custom wheelchair arrived on the fifth week of rehabilitation, after which all wheelchair skills were reviewed to ensure safety in his personal chair. Though fearful of the task, Client A was able to maneuver small one-inch "wheelies" after several sessions of practice to improve access to his

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environment. He was encouraged to practice this skill with outpatient therapy after discharge to improve safety and efficiency with community mobility.

Balance Training

Client A participated in seated balance training, in both short and long-sitting, on most therapy days. Over the two weeks, Client A practiced reducing upper extremity support during short-sitting on the edge of the mat. After Client A demonstrated good sitting balance without bilateral upper extremity support, he started additional seated balance training including perturbation-based training with eyes open and eyes closed and reaching activities outside of his base of support. By the third week, Client A was able to comfortably pick up small objects, such as a pencil, off the floor while sitting at the edge of the mat or in his wheelchair. Work-related functional tasks were also incorporated into Client A's balance training to promote engagement and skill carry over into his daily tasks after discharge. This included having Client A build and fix objects from varied angles and surfaces on the mat.

Other Therapy Interventions

Client A participated in other therapy activities to maintain his health and promote neurological recovery. Client A stood in a standing frame to maintain bone integrity and cardiovascular health. This activity was dosed at two sessions per week, for 30 to 40 minutes at a time, above 80 degrees of standing with systolic blood pressures remaining stable over 100 millimeters of mercury. By the eighth week of rehabilitation, Client A was able to manage the standing frame set-up independently. He was ordered a personal standing frame for continued use at home upon discharge.

Client A also participated in lower extremity functional electrical stimulation (FES) cycling on an RTI300 bike. Electrodes were positioned on his bilateral quadriceps, gluteus maximi, hamstrings, soleus and tibialis anterior during each session, and stimulation was administered at maximal intensity per muscle group at 40 hertz. Each cycling session lasted 35 to 40 minutes with 30 minutes of motor support. Client A did not participate in any FES training on Week 6, as detailed in the *Complications* section under **Outcomes** below. By the time of discharge, he was independent with the FES set-up and intervention. He planned to order a unit for home use to continue his exercise program. Client A also practiced biking on the Nu-Step for an average of 60 to 90 minutes per week, using mostly arms to facilitate, to maintain his cardiorespiratory fitness.

Range of motion and stretching exercises were dosed at 10 to 30 minutes per day, most days per week, to preserve joint integrity. These exercises were practiced in all planes for bilateral hips, knees, and ankles. Throughout his therapy course, Client A did not develop any contractures.

Education

Client A participated in one formal 60-minute educational session with the physical therapist who provided a thorough overview of life adjustments after a spinal cord injury, as described in Burns and Hammond's *Yes, You Can* book. Client A was provided a copy for personal use. The physical therapist also incorporated informal educational lessons into most therapy sessions, including topics on spinal cord anatomy, autonomic dysreflexia, pressure relief management, health maintenance strategies, and prognosis. Several other staff members also provided formal and informal educational lessons over various spinal cord injury topics throughout their interaction with Client A.

Other Rehabilitation Services

At the rehabilitation center, Client A participated in daily occupational therapy sessions to work on improving bed mobility and transfers, balance, upper extremity strengthening, total body dressing and hygiene cares. Additionally, he participated in recreational therapy and vocational rehabilitation to

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work towards community reintegration and reinforce skills being practiced in therapy, such as wheelchair mobility skills. He also attended sessions with the neuropsychologist on an as-needed basis.

Medical Intervention

Throughout Client A's rehabilitation, he continued medical treatments under the guidance of a physical medicine and rehabilitation team. In total, Client A underwent two rounds of IV prednisolone, two doses of plasmapheresis, and five rounds of IVIg between symptom onset and inpatient rehabilitation discharge. He was treated with various doses of baclofen, valium and diazepam for spasticity management. Enoxaparin was used as both a preventative and reactive treatment for deep vein thrombosis. Additional medications were used for pain and mood management.

Outcomes

Client A was discharged to his home with his spouse after nine weeks of inpatient rehabilitation. The etiology of his transverse myelitis was never confirmed but was presumed to be postinfectious in nature. He recovered some sensory and motor function and had a new ASIA classification of T4 ASIA C paraplegia at the time of his discharge. Specifically, improved motor contraction was observed, as Client A recovered 1/5 strength in all bilateral lower extremity muscles. Client A had some increases in light touch sensation, though distribution was patchy. Distinct sensory and motor levels remained unchanged. There were no notable changes in Client A's range of motion upon discharge. A skilled physical therapist with more than ten years of experience did measure and observe increases in muscle strength per manual muscle testing that were inconsistent with the ASIA motor findings reported by the physician. Functionally, Client A did not regain the ability to stand or ambulate while in inpatient rehabilitation. He did achieve full independence in most FIM tasks with exception of the gait and stairs categories. In terms of mobility, he was able to safely complete lateral transfers with and without a transfer board. He was independent with all activities of daily living and was planning to return to work. With a new addition of a ramp and some interior remodeling, his home was fully accessible and safe for his return. The scores of his outcome measures at discharge are listed in **Table 3**.

Complications

Client A reported having a cramping sensation in his left calf on his fifth week of rehabilitation and was diagnosed with an occlusive deep vein thrombosis in his proximal gastrocnemius veins via Doppler ultrasound. He was then treated with a higher dose of enoxaparin to prevent further clot propagation. All therapies were held for two days after diagnosis to avoid provocation. Functional electrical stimulation to the lower extremities and aggressive stretching of the calf were also halted until clot resolution and physician approval were confirmed.

Discussion

Transverse myelitis is a complicated disorder that can significantly impact an individual's ability to move, work, and participate in daily activities. Only a few prognostic factors have been documented in the literature. Presence of spinal shock, a rapid progression of symptoms, and severe back pain have been reported as poor prognostic factors over the last two decades.[16,17] A more recent 2018 study observed that an older age at time of symptom onset and infectious etiology, as well as peripheral nerve involvement, may also indicate poor prognosis.[18] Several studies have emphasized the importance of quick detection and accurate diagnosis in optimizing patient outcomes. Certain treatments not only may be less effective but also detrimental in certain populations. For example, specific drugs targeted to treat NMO-related TM have shown to exacerbate MS progression.[2] For

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infectious etiologies, antiviral or anti-bacterial drugs must be considered to improve recovery. Client A never received a clear etiological diagnosis, as his presentation and lab results did not perfectly match any specific category. This lack of clarity may have negatively impacted his care and his prognosis. Despite this, his active participation in a multidisciplinary rehabilitation program greatly improved his functional outcomes.

Table 3: Admission and Discharge Outcome Measures

	Admission Assessments		**Discharge Assessments**	
ASIA	**Right Sensory**	**Left Sensory**	**Right Sensory**	**Left Sensory**
	Pinprick: T4	Pinprick: T4	Pinprick: T4	Pinprick: T4
	Light Touch: T4	Light Touch: T4	Light Touch: T4	Light Touch: T4
	Right Motor: T4	**Left Motor:** T4	**Right Motor:** T4	**Left Motor:** T4
	Anal Sensation: *Yes*	**Anal Contraction**: *No*	**Anal Sensation**: *Yes*	**Anal Contraction**: *No*
MMT	**Right**	**Left**	**Right**	**Left**
	Hip flexion: 0	Hip flexion: 0	Hip flexion: 1	Hip flexion: 1+
	Hip extension: 0	Hip extension: 0	Hip extension: 1	Hip extension: 1
	Hip abduction: 0	Hip abduction: 0	Hip abduction: 0	Hip abduction: 0
	Knee flexion: 0	Knee flexion: 0	Knee flexion: 1	Knee flexion: 1
	Knee extension: 0	Knee extension: 0	Knee extension: 2	Knee extension: 2
	Ankle dorsiflexion: 0	Ankle dorsiflexion: 0	Ankle dorsiflexion: 1+	Ankle dorsiflexion: 1+
	Ankle plantarflexion: 0	Ankle plantarflexion: 0	Ankle plantarflexion: 2	Ankle plantarflexion: 2-
	Great toe extension: 0	Great toe extension: 0	Great toe extension: 1	Great toe extension: 2
FIM	**Task**	**Score**	**Task**	**Score**
	Feeding	7	Feeding	7
	Grooming	7	Grooming	7
	Bathing	3	Bathing	6
	Upper Body Dressing	1	Upper Body Dressing	7
	Lower Body Dressing	1	Lower Body Dressing	7
	Toileting	1	Toileting	6
	Bladder Management	1	Bladder Management	6
	Bowel Management	1	Bowel Management	6
	Bed, Chair, W/C Transfer	3	Bed, Chair, W/C Transfer	6
	Toilet Transfer	1	Toilet Transfer	6
	Tub/Shower Transfer	1	Tub/Shower Transfer	6
	Walking	1	Walking	1
	Wheelchair	5	Wheelchair	6
	Stairs	1	Stairs	1
	Comprehension	7	Comprehension	7
	Expression	7	Expression	7
	Social Interaction	6	Social Interaction	6
	Problem Solving	7	Problem Solving	7
	Memory	7	Memory	7
MAS	**Right**	**Left**	**Right**	**Left**
	Hip flexors: 2	Hip flexors: 2	Hip flexors: 1+	Hip flexors: 0
	Hip extensors: -	Hip extensors: -	Hip extensors: 3	Hip extensors: 1
	Hip adductors: 2	Hip adductors: 2	Hip adductors: 1	Hip adductors: 1+
	Knee flexors: -	Knee flexors: -	Knee flexors: 1+	Knee flexors: 1+
	Knee extensors: 2	Knee extensors: 2	Knee extensors: 1+	Knee extensors: 1+
	Soleus: -	Soleus: -	Soleus: 1+	Soleus: 1+
	**Exam limited due to pain*		**Sustained clonus in both ankles with dorsiflexion*	

Abbreviations: (-) Not tested

Though Client A had a preceding varicella zoster infection, he did not fit well into a varicella zoster-induced myelitis group for several reasons. Most individuals affected by infectious transverse

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myelitis are immunocompromised and reach maximal symptoms within 14 days of the infection.[2-4] Client A's symptoms reached nadir four weeks after his rash onset. There was also no evidence of an immunocompromised state at the time, though he still may have had a discrete and undiagnosed condition. Another complicating diagnostic factor is that no IgM antibodies appeared in any cerebrospinal fluid sample. Historically, to be diagnosed with postinfectious TM, either observation IgM antibodies or a four-fold increase in IgG antibodies was required.[4] Interestingly, Client A also had IgG for mycoplasma and West Nile virus. These were presumed to be old infections, however, due to lack of IgM in the samples. Another intriguing fact is that Client A had tick bites at the time of peak symptom intensity. It could be hypothesized that a second, tick-borne infection may have triggered his symptoms and led to transverse myelitis in a varicella zoster-induced immunocompromised state. No signs of any tick-borne infection, however, were observed in his laboratory studies. Though no clear infectious agent was confirmed as the instigator of Client A's transverse myelitis, his case is best labeled as postinfectious. The prior shingles event does exclude his case from being classified as idiopathic according to the criteria described by the Transverse Myelitis Consortium Group.[4]

It is also important to note that Client A's poor response to standard TM medical treatments may have contributed to his prognosis. Client A did not demonstrate improvement with acyclovir, a commonly used antiviral drug for varicella zoster and zoster-induced myelitis.[19] He also had a severe reaction to the albumin in plasmapheresis, which is extremely rare. Only a few cases of albumin-reactions have been documented in the literature.[20] These reactions, however, can be fatal if not recognized and managed quickly.[20] Plasmapheresis is an otherwise safe and well-supported treatment option for autoimmune-based disorders and has shown to be particularly beneficial in patients with TM presenting with complete paralysis.[14] Client A also had a reaction during one of his steroid treatments. Taken together, these complications limited his medical intervention options, delayed his rehabilitation admission and thus, likely negatively impacted his neurological recovery.

Though Client A had a challenging medical course, he still improved in his functional mobility with intense physical and occupational rehabilitation. Upon admission to the rehabilitation center, Client A required maximal assistance with most tasks. He was unable to dress himself, manage bathroom cares and transfer between surfaces. At discharge, he was independent with most tasks. Repetitive task-specific training is a well-supported principle in spinal cord injury rehabilitation.[7] In this case, these tasks clearly improved Client A's functional outcomes. The addition of balance training also appeared to increase Client A's safety with bed mobility and transfers, as well as his confidence. These less stressful tasks were easy to incorporate and observe progress. Functional electrical stimulation (FES) on the RTI300 bicycle was added into Client A's rehabilitation to promote neurological recovery and maintain musculoskeletal health. Research has shown FES training to preserve muscle mass, cardiovascular fitness and bone integrity through initiating strong muscle contractions.[7] In turn, evidence has demonstrated that maintaining these physical characteristics preserves metabolic health and reduces risks for secondary diseases.[7] A standing frame regimen was also performed to maintain range of motion, cardiovascular function and bone health.

It is also important to credit Client A in his therapy progress, as his personal characteristics likely impacted his care in a positive manner. First of all, he lacked common cardiovascular and endocrine comorbidities that would have likely further exacerbated his new condition. His excellent physical fitness and upper body strength facilitated his progression with transfers. He was an active participant in his healthcare and rehabilitation. He demonstrated high self-efficacy by practicing tasks under the least restrictive conditions to improve his independence. He had a supportive spouse who participated in rehabilitation sessions and other appointments when available. Client A was hopeful, resilient and strived to remain positive despite his new circumstance.

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Future Rehabilitation Recommendations

In all cases, it important to reflect potential changes that could have benefitted patient care. Increased total time and intensity of wheelchair training should have been considered. An abundance of literature supports increased wheelchair training in rehabilitation. New manual wheelchair users identify correct propulsion techniques, rough terrain navigation, and curb navigation as important skills to improve independence in the community and reduce injury.[21] Ability to perform advanced wheelchair skills is also associated with reduced injury risk, improved social integration and enhanced quality of life.[22] Therefore, Client A would likely have benefitted from additional wheelchair practice, especially with “wheelie” and floor-to-chair transfer training.

Additionally, keeping track of improved independence with other outcome measure tools may also show promise. No information is available for the minimal detectable change or minimal clinically importance difference for the FIM. Most facilities have also discontinued the FIM, as of October 01, 2019, and have transitioned to the new GG Self Care and Mobility Activities coding system to meet Medicare standards. No research is currently available on this outcome measure to date.

Conclusion

This case report describes the rehabilitation and medical interventions utilized with an individual diagnosed with postinfectious transverse myelitis. Client A’s slow symptom onset, unclear diagnosis and poor responses to medical interventions may have negatively impacted his care. Despite this, Client A achieved independence in all functional independence categories with exception of gait and was able to discharge to his home. In this case, multidisciplinary care including physical rehabilitation likely improved his functional outcomes and quality of life after his discharge and should thus be considered for all individuals with new diagnoses of transverse myelitis.

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